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ARISTOTLE ON THE PARTS OF ANIMALS

Aristotle on the Parts of Animals. Translated, with Introduction and Notes, by W. Ogle, M.A., M.D., F.R.C.P., sometime Fellow of Corpus Christi College, Oxford. (London: Kegan Paul and Co., 1882.)

THE translator and commentator of this learned work, in speaking of the many erroneous statements in the text of the master, tells us we have only to remember the strange vicissitudes to which the original manuscripts of Aristotle's treatises are said to have been subjected, to obtain a fair reason for the occurrence of these errors. "Hidden under ground in the little town of Scepsis, to save them from the hands of the kings of Pergamus, who were then collecting books to found their famous library, and who, in so doing, apparently paid but little regard to the rights of individual owners, they were left for the better part of two centuries to moulder in the damp, 'Blattarum et tinearum epulæ'; and when they were at last brought to light fell into the hands of Apellicon of Teos, a man who, as Strabo says, was a lover of books rather than a philosopher, and who felt no scruple in correcting what had become worm-eaten, and supplying what was defective or illegible."

In putting this explanation of the errors found in the works of Aristotle before his readers Dr. Ogle seems to have ignored another explanation, which has also been supported, namely, that Aristotle himself intentionally rendered some parts of his treatises obscure. Certain of our English classics have quoted or referred to the correspondence reported to have occurred between Alexander the Great and Aristotle. Alexander having heard, while he was in Asia, that the books of his master were exposed to public sale, is reported to have expressed himself as extremely disgusted that such profound knowledge was laid open and made plain to common understandings, and wrote to the master urging this complaint, and that when the doctrines and precepts communicated by him in private were spread over the world, he should have no wisdom to boast of above the meanest of his subjects. To this Aristotle is said artfully to have replied that he had indeed exposed his works to public sale, but had cast such a veil over them that not one eye in a thousand would be able to discover what lies concealed under them. It had, we think, been fortunate for Aristotle if the mystery made to surround his works had been confined to the little town of Scepsis, and if the many prevarications in respect to them had been confined to the hands of Apellicon, of Teos. For, until recently, it has happened that Aristotle generally has been read and written upon by lovers of books rather than philosophers, and that he has, consequently, been misrepresented high and low, far and wide. Of Aristotle indeed it may be said as Antony said of Cæsar—

The evil that men do lives after them;
The good is oft interred with their bones.

He is much more remembered by the masses from the infirmities which are attributed to his career, than from the details of his work. The picture of his personal appearance and manner, his effeminate voice, small eyes, spindle

shanks, love of dress; his withdrawal from the Academy; the treatment of him by Plato as a truant and fugitive, who, like an insolent chicken, pecked at his mother hen; his bluntness and supposed discourtesy to his pupil Alexander; his retirement to the court of Hermias, and his assumed intrigues with that tyrant; his marriage with the sister or concubine of the tyrant, and the absurd homage he is declared to have paid to the woman of his admiration; these are all topics which, true or false, have floated down and connected themselves closely in the popular mind with Aristotle as a man living a strange life rather than as a philosopher living a life of philosophy.

They who, irrespective of all these reflections, have tried to read this master from himself, and, with singleness of mind, to understand him in his greatness, will feel no little delight in studying the volume which Dr. Ogle, with learned love for his theme and its author, has put before the world, and for which all scientific men will feel deeply obligated. It is not only that in 140 pages of fine English he has translated this work of Aristotle "On the Parts of Animals," but that he has also written an "Introduction" of thirty-three pages, which prepares the mind of every student for the reception of what is to follow, and has added 111 pages of closely-printed matter, containing notes of an explanatory kind bearing upon all the doubts and difficulties of the text.

The introduction to the work brings before us the mind of Aristotle in respect to his ideas of the origin of created things. In his period, as in ours, there were two schools of philosophical reasoners on beginnings. There was a school which fancied it had found an adequate cause for the phenomena in the necessary operations of the inherent properties of matter. There was another school which discovered a solution in the intelligent action of a benevolent or foreseeing agent which they called God or Nature. Between these opposite views, says our author, Aristotle had to decide, and he decided for neither exclusively, but for both, although in very unequal degrees. "The motions of the heavenly bodies are governed by necessity and by necessity alone. But in the works of nature, that is, in the phenomena of terrestrial life, this necessity is a comparatively unimportant factor." Most is the outcome of design. Still some part, though but a small one, is the result of necessity. There is indeed one sense in which everything in the animal body may be said to be the result of necessity. When a man builds a house, he must, in order to realise his plan, of necessity have walls, roof, and the like. To have these he must first have bricks, stones, mortar, and what not; and again, to furnish these, clay, lime, and the other necessary materials. So it is with the animal body. The design of nature cannot be carried on without the necessary antecedents. In this sense then all parts of the body, and all the successive stages by which they are developed, one after the other, may be said to be the result of necessity, for all must necessarily be there if the plan of nature is to be realised.

From the materialists, however, Aristotle is shown to differ. They contended "that organisms are evolved as necessary consequences of the inherent properties of matter." This Aristotle admitted and disputed. In some measure he considered that what they said was true, but

that measure is small; for nature, in making plants and animals, can but use such material substances as exist; she does the best she can with the materials that are at hand, but the properties of those materials are beyond her control, and such consequences as follow upon those properties are the results of necessity.

Dr. Ogle, describing this view of his author, refers to the singular reference which Galen long after made to the same view, and to the criticism Galen offers on the Mosaic tradition of the creation, a work he had evidently read with much care. Galen disputes with Moses on the point that the Creator can make an animal of any matter he chooses—a man from a stone, an ox from dust. “This,” says Galen, “we deny. The laws of matter are antecedent to the Creator, and obligatory upon Him.”

Aristotle in his teaching was as little Agnostic as Moses himself. The creative mind, the mind that is like to the human mind, only so infinitely mightier and more original in design, is in nature, and, whether as first or second, is sufficiently above human nature as to be to it a creator, a designer, a maker. “It is ridiculous,” he says, “to suppose that such phenomena as those of organic life are merely the result of chance.” The very essence of chance is uncertainty. Chance is the principle of the inconstant. “But the phenomena in question present a high degree of constancy, and can be foretold with more or less of precision. It is quite plain that, besides the necessary forces of matter, there is something else at work which guides and co-ordinates these, so as to make them converge to a predetermined end. If a man cannot see this, it is absurd to argue with him; as well try to convince a man born blind, who denies the existence of colour. You see a house or a ship, and without hesitation you infer that such house or ship was made for the purposes to which ships and houses are subservient. Why? Because they are manifestly adapted to those purposes. Why, then, when you see a plant or an animal with equally manifest adaptations do you hesitate to draw a similar inference? True, in one case you can see the agent at work, while in the other the agency is invisible. But why should this make any difference? The agency in the latter case is invisible because it is an internal force, a something acting inside the material. It is as though the invisible shipwright were away and his art were inherent in the timber itself. Moreover, if the agency itself is out of sight, the model from which it works is visible enough, is as visible and palpable as the model of the ship or the plan of the house, and, like them, examinable before either is constructed.” Could Aristotle have seen at work one of our modern power looms and have observed how, so long as it was fed, it produced results that unconsciously converge to a predetermined end, he would have drawn from this source another and striking illustration. He would have said here is another instance of an invisible agency working as if the art were truly inherent in the thing itself. It is matter in motion and in direction, producing something by fixed rule, but dependent, nevertheless, on something else which is independent and antecedent.

The great argument left behind, we follow the master to lower but still exalted fields of thought, speculation, and description. We follow him from the metaphysical to the physical, from the formative principle to the things that

are formed, and from these in their details rather than in their mass. It is in this part of the original work that the critic comes in with power, and is able to try the quality of Aristotle by the hard test of examination of fact, by the side of statement. Thus adjudicated upon, Aristotle is found to be wanting, or, to use a word that has been applied to him, a “failure.” He is said to fail in description of objects actually before his eyes. He is said to fail in generalisation, to have been hasty in generalisation, and to have reasoned on too small a basis of facts. Lastly he is said to fail in method, a failure which was certain to follow if the facts and the generalisations from them are both at fault.

Against all these charges Dr. Ogle defends Aristotle with true and honest skill. He does not defend error nor gloss over defect. He takes the natural common-sense view that Aristotle, in the conditions under which he lived and worked, performed the most signal services: that when he failed to see as we see, he failed because he had no means of seeing; that when he failed to generalise correctly, he failed because the stage to which biology had attained in his time made failure a matter of necessity; that he failed in method because in fact his was the first method, and because verification, which is essential to perfection of method, “does not find its proper sphere in the early condition of a nascent science, when the generalisations are merely provisional, and the false yet necessary precursors of more accurate ones.”

The defence really leaves nothing to be desired; it is that which the master would, we believe, have made of himself by himself, could he speak for himself.

If there be one observation which in difference and in deference, we would offer in respect to this defence, it is on the comparison which is drawn between the *Timæus* of Plato and the work of his contumacious pupil. We admit that it “is the gap which separates the man, Aristotle, from his predecessors, not that which lies between him and his successors which gives the true measure of his position.” We admit that when any one compares Aristotle’s physiology with that of the *Timæus*, there is a wide distinction, but are we, really, in the transit “conscious of passing into an entirely new order of things?” We cannot declare this possible with such confident affirmation. It may be fairly said that a great deal in the *Timæus* is of airy and fanciful construction, but we do not think it fair to affirm that the construction is one “in which imagination alone supplies the foundation, and in which facts, if introduced at all, are introduced merely as ornamental additions in no wise essential to the fabric.” This is a harsh judgment, and the more so because we are bound to take Plato as the prompter of Aristotle, and the teachings like those in the *Timæus*, with all the imaginings and poetry, as the promptings of the “Parts of Animals.” To our minds it would be only just to say that the “Parts” was written on the Platonic design, and that if the teachings of Plato had not been placed before Aristotle his more correct and matter-of-fact work had never been born.

The “Introduction” of Dr. Ogle is followed by a chapter entitled “The Main Groups of Animals,” in which the chief groups recognised by Aristotle are arranged as follows:—

I. Sanguineous Animals (Vertebrata). A. Vivipara (Mammalia). 1. Man; 2. Quadrupeds; 3. Cetacea. B.

Ovipara. *a.* With perfect ovum. 4. Birds; 5. Quadrupeds and Apoda (Reptiles and Amphibia). *β.* With imperfect ovum. 6. Fishes.

II. Bloodless Animals (Invertebrata). *a.* With imperfect ovum. 7. Malacia (Cephalopods). 8. Malacostraca (Crustacea). *β.* With scolex. 9. Insecta (remaining Arthropoda and some Vermes). *γ.* With generative slime; buds; or spontaneous generation. 10. Ostracoderma or Testacea (Mollusca excepting Cephalopods). *δ.* With spontaneous generation only. 11. (Zoophytes).

After this the text of Aristotle follows in four books, preceded by a Synopsis, and succeeded by the Notes, to which we have already directed attention. How excellently the notes are used to illustrate the text may be shown by one or two quotations. In Book III. Chap. V. Aristotle describes "that in animals of great size the heart has three cavities; in smaller animals two; and in all at least one."

"The reason for this, as already stated, is that there must be some place in the heart to serve as a receptacle for first blood. But inasmuch as the main blood vessels are two in number, namely, the so-called great vessel and the aorta, each of which is the origin of other vessels; inasmuch moreover as these two vessels present difficulties, it is of advantage that they also shall themselves have distinct origins. This advantage will be obtained if each side have its own blood and the blood of one side be kept separate from that of the other."

So much for the text. The notes in the most useful manner explain away one attributed error by Aristotle, while they remove one apparent error. They show that the statement universally made by writers on physiology that up to the time of Galen all philosophers supposed that the arteries contained nothing but air is incorrect, inasmuch as the text shows that Aristotle knew perfectly well that the arteries contain blood. They show again that Aristotle's apparently erroneous view about the cavities of the heart does not prove him ignorant. The three cavities he refers to are the right ventricle, the left ventricle, and the left auricle. He omitted the right auricle simply because he looked on it as a venous sinus, a part, not of the heart, but of the great vein, *i.e.* superior and inferior venæ cavæ. That he so regarded it is plain from his always speaking of the superior and inferior venæ cavæ as forming a single vessel, not two distinct vessels, and that the heart appears very much like a part of the great vein, being interposed between its upper and lower divisions.

Turning to another note bearing on a different, and, as we should now say, a chemical subject, we are offered an insight into the views of the philosopher, on the composition of natural substances. In the first chapter of the second book, the philosopher, in speaking of composition, says that there are three degrees of composition; and that the first of these, as all will allow, is out of what some call the elements, such as air, earth, water, fire. Perhaps, however, he adds, it would be more accurate to say composition out of the elementary forces; nor indeed out of all these, but of a limited number of them. With this observation as a text, Dr. Ogle explains that Aristotle in his other works is seen not only to look upon compounds as combinations of elements, but indeed to have a clear conception of the distinction between chemical combination and mere mixture: "for of the former he says that the

combining substances disappear with their properties, and a new substance with new properties arises from their unification. In the latter, the mixed substances remain with all their properties, and it is merely the imperfection of our vision which prevents us from seeing the particles of each lying side by side, and separate. Had we the eyes of Lynceus, we should do so, however intimate the mixture might be." This knowledge is remarkable, though it may not be complete, or may not be completely expressed. It suggests an anxious desire to know more of the sources of knowledge from whence this master drew his chemical learning.

One more illustration from these useful notes belongs to the domain of natural history, and is connected in a way, singularly interesting, with history in a more general sense. Speaking in Book III. Chapter II. of the right and left organs of the bodies of animals, Aristotle says that the horns of animals are, in the great majority of cases, two in number. There are, however, exceptions, he thinks, to this rule in respect to the horns, for there are some that have but a single horn—the Dryx and the so-called Indian Ass. In such animals the horn is set in the centre of the head; for, as the middle belongs equally to both extremes, this arrangement is the one that comes nearest to each side having its own horn. Dr. Ogle, in his note on this passage, points out that the account of the Indian Ass, with a solid hoof and a single horn, was taken by Aristotle from Ctesias, and that it has been plausibly conjectured that the Indian Rhinoceros (*R. unicornis*) is the animal meant; for though, he says, this animal has three toes, they are so indistinctly separated that the real character of the foot might easily escape a casual observer. At the same time he observes that on the obelisk of Nimroud, made long before the time of Ctesias, there is represented a rhinoceros with feet distinctly divided into toes. An argument on the side of this supposed identification is, he adds, furnished by the fact that the horn of the Indian Ass was supposed to have certain magical powers, so that a cup made from it gave the drinker immunity from poison, as is related by Philostratus in his life of Apollonius; whilst similar virtues are assigned, in the East, to rhinoceros horn, even in the present day. If the one-horned ass of India be the *Rhinoceros Unicornis*, may not the asses with horns named by Herodotus as among the animals of Lybia, be the two-horned Rhinoceroes of Africa?

We have selected three illustrations of text and notes, one from anatomy proper, another from chemistry, a third from natural history, for the purpose of giving the reader a taste of the useful and most interesting study that lies before him when he takes up this book. We have rarely seen a volume which so intimately connects the science of the remote past with the science of the present, and which bridges over the distance as this book does. If there be a fault in it, it is that of condensation. In trying to compress and compress, and again compress, Dr. Ogle gets into the mode of using the first letter of the name of his author or book in his references; he also, for the same reason, in his note references, omits the page of the volume, and, as he does not supply a complete key to his method, he is sometimes, like "Bradshaw," rather vexatious, especially when his follower is anxious to discover quickly how to travel with facility from one point to

another. On this detail, however, it were ungrateful to dwell with too much emphasis, and the more so as our own slowness of perception may have added greatly to the difficulty. It is far more pleasant in concluding, to propose to him a hearty vote of thanks, and to express the earnest hope that he will soon place before us some other classical work once buried in Scepis or elsewhere, in similar English dress and form.

BENJAMIN WARD RICHARDSON

FLAMMARION'S "ASTRONOMY"

Les Étoiles et les Curiosités du Ciel. Par Camille Flammarion. (Paris: C. Marpon et E. Flammarion, Éditeurs, 1881.)

WHATEVER may have been the cause of that development of astronomical taste in England which would so greatly astonish our resuscitated forefathers, and is a puzzle to some plain-thinking people even at this day, the fact admits of no doubt; and a very cheering fact it is to those who value the intellectual and æsthetic progress of their fellow-countrymen. But it is perhaps not so generally known that a movement of the same nature has been in progress among our neighbours across the Channel. It originated later in point of time; for France had entered into no such competition when the Herschels, Lassell, Dawes, Smyth, and other non-professional observers were attracting the notice of all Europe by their discoveries; and we recollect, less than twenty years ago, having heard from M. Léon Foucault a candid admission of the inferiority of his own country in amateur observation. But the Gallic mind is more rapid in its movements than our own; and though later in the field we are not sure that they are not shooting ahead of us in these matters in a way that we in general are perhaps hardly prepared to expect. At least, the fact mentioned in the volume before us, that during two years previous to last October, 300 telescopes had been sold to French purchasers, may be accepted as rather a startling proof: and not less so is the extraordinary circulation of the works of M. Flammarion, whom we may justly call the leader of the movement. As many as 50,000 copies in two years have been printed of his "Astronomie Populaire," of which "Les Étoiles" is considered the supplement; his "Merveilles Célestes" have reached 38,000; and his "Pluralité des Mondes" has come out in a 30th edition; to say nothing of other works of remarkable acceptance. Nor is it probable that the success of this publication will fall below that of its predecessors, treating as it does of a most interesting subject in an especially agreeable and familiar way. It is certainly not a volume which an English publisher would like to risk—an octavo of the largest size, of nearly 800 pages, and thick and heavy in proportion; anything in short but a handbook; but this, which would discourage an English buyer, is evidently no objection in the eyes of a Parisian firm. And it must be owned that in many respects it may well command a wide circulation. The idea is that of exhausting all the wonders of the sidereal heavens that the naked eye can reach, and describing their telescopic aspect; and it is excellently carried out for popular purposes; and we may add in certain respects for scientific ones also. The great value of the work consists in the especial pains taken with the

probable changes of brightness in a multitude of naked-eye stars, not included in the ordinary enumeration of variables; but it is interesting in many other respects; and the close is enriched with a number of catalogues of telescopes, double and coloured and variable stars, their spectra, proper motions, parallaxes, and other data; together with many descriptions of planets, comets, &c. In short, it is a mine of information for those who do not care to dig deep; and those who would desire more authenticated and *weighted* details (observers will understand the word) may yet meet with much of interesting and valuable suggestion. The book has, however, some drawbacks which ought to be noticed.

Among many useful and some needless illustrations, there are a few (as that of the nebula in Andromeda, where the canals are invisible) of a very inferior stamp; and it is not free from carelessness in assertion, and even misleading statements; for instance, where Hevel is represented (p. 403) as never having in his life used the telescope for purposes of observation. The author should have said, as applied to divided instruments; or we might think he had forgotten the "Selenographia." Nor can we suppose that he made much inquiry as to the classical meaning of "in diem" (p. 525) when he rendered it "pendant le jour." The mythological part is more amusing than valuable: more agreeable perhaps to French than English taste; the theological—if it may be so called—is not only out of place, but worthless.

However, on the whole, the work displays a vast amount of industry and a wonderful range of knowledge; and the enthusiasm of the author for his subject is truly refreshing. Even when a process of unacknowledged appropriation has been indulged in, the borrowed plumage has been so ingeniously adapted and so gracefully worn as almost to claim unmerited forgiveness; but whencesoever his materials may be drawn he manipulates them with accomplished dexterity. His facile and lively style carries us most pleasantly along, and if his passionate eloquence is occasionally rather turgid for our more moderate temperament, it is sometimes exceedingly powerful and impressive. A more thoroughgoing manual might be produced for close practical study; but—allowing for the defects that we have mentioned—nothing that we know of as yet equals it for familiar use and attractive illustration.

OUR BOOK SHELF

Populäre Astronomie von Sim. Newcomb, Astronom in Washington. Deutsche vermehrte Ausgabe, bearbeitet durch Rud. Engelmann, Dr. Phil. (Leipzig: Engelmann, 1881.)

THIS is much more than a simple translation of Newcomb's "Popular Astronomy," reviewed in these pages at the time of its publication. The editor thinks that as the original work was mainly written for American students, it would only be fair to German students and astronomers that the German edition should be adapted to a German standpoint. At the same time there is little trace of any special nationality in this edition, the aim of the editor having been rather to make it as complete and comprehensive as possible. Considerable additions have therefore been made both to the text and the illustrations, all of them we think improvements. In the second part, for example, much additional information has been added with reference to instruments and methods; additional